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A SYSTEMATIC SNAPSHOT REVIEW OF CUSTOM-MADE SOFTWARE ENTERPRISES FROM THE DEVELOPMENT PERSPECTIVES

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ABSTRACT

Nowadays, many organizations are required to develop custom-made software enterprises with its own characteristics by In-house software development companies. It is very complex to deal with custom demands from different environments by a general process from development perspectives. This study attempts to investigate the development perspectives on custom-made software enterprises over the past eleven years. A systematic snapshot methodology was conducted on the gathered published papers between the periods from January 2007 to October 2018. According to the inclusion and exclusion criteria, 102 papers were identified. Reviewed articles addressed 6 primary phases of the software development life cycle (SDLC). Implementation phase was the most commonly used in 35% of paper's investigations. Case study design was the most common approach used in 26% of papers. This study presents decisions for trending to future researches based on systematic mapping findings that revealed in gap research forum covering development issues.

KEYWORDS: Literature Review, Custom-Made Software, Development Perspectives & Systematic Snapshot

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Original Article

1. INTRODUCTION

Every decade, software engineering researchers produce updated methods in different directions of software development. This guide the In-house software development companies with their team members to deal with different types of software such as packaged software, custom-made software or hybrid software according to follow the produced recourses in development perspectives. It is clear that dealing with packaged software easier than custom-made software in order to the process of eliciting the project requirement engineering. Custom-made software has been produced at In-house at software development companies, which is known as tailor-made software or bespoke software. Custom-made software is considered one of the most critical types of software systems that deals with the challenging diversity of studying, analysing and developing in accordance to customer specific demands, and customization process(Regnell & Brinkkemper, 2005; Sawyer, 2000). Therefore, In-house software development companies engage in lengthy negotiations with the stakeholders of organizations to develop a specified software requirements(L. Xu & Brinkkemper, 2007).

Custom solutions have become popular across organizations, institutes, governments, and other sectors worldwide. These solutions can be either as large enterprises or small enterprises. Based on Laporte et al. investigations of classifying very small enterprises (VSE) the importance of software size determines whether it is used in large projects or SME projects according to the characteristics of their software requirements specifications (SRS) (Laporte, Alexandre, & O'Connor, 2008), and according to the European Commission (EU) (Commission, 2003) micro, small, and small-to-medium classifications, the importance of the software size can be described whether these enterprises used in large projects or SME projects. For that, not only do large organizations have custom-made solutions but as well small and medium enterprises (SMEs). In SMEs, this software is known as small custom-made software or small bespoke software (Allison, 2010).

The development of custom-made software differs from commercial off-the-shelf (COTS) and packaged software products(Keil & Carmel, 1995)in terms of that custom-made software meets individual clients and demands, cost of development is expansive more than packaged software, a customized requirement management, untradeable products(Holland, Light, & Gibson, 1999). It determines the characteristics of management aspects in order to understand tailoring criteria, rationale, and implications of the defined project management criteria(Kalus & Kuhrmann, 2013). In this context, the purpose of this systematic snapshot review of custom-made software enterprises is to present a wide investigation of literature according to the software development life cycle classifications for discovering the covered research issues and the uncovered issues based on the systematic mapping gaps.

1.1 Article Structure

This article is organized as follows; section 2 introduces the recent literature review of the most relevant systematic snapshot studies. Section 3 introduces the material and methods for the systematic mapping process. Section 4 presents the results of the systematic snapshot mapping on the custom-made software with different types of classification schemas. Section 5 shows the findings, discussion. Finally, section 6 concludes the paper content.

2. LITERATURE REVIEW

This section summarizes the most relevant contributions of the recently published papers. The reviewed literatures were conducted using the systematic snapshot approach in software engineering (SE) areas.

In 2013, Georg Kalus & Marco Kuhrmann (Kalus & Kuhrmann, 2013) conducted a mapping study to specific project requirements called tailor software or custom-made software. It aimed to present a systematic literature survey (SLR) to develop a catalogue that was suitable for the project-specific software in the implication's perspective. This mapping dealt with analysing the impact of the tailored software criteria in the software engineering management by relying on the project characteristics and processes of tailoring software enterprises. In 2018, Tahir et al.(Tahir, Rasool, & Noman, 2018) conducted a mapping study to investigate the software measurement programs in SMEs for 35 primary studies in order to show the difference between the SMEs and large organizations. It aimed to recognize, explore, and classify the studies on software measurement programs in the period between 2001 and 2016 to the relevant gathered research papers. In 2017, Tamimi, M., & Jebreen (Tamimi & Jebreen, 2018) conducted a mapping study of small packaged software with a development perspective interest of 101 research papers between the periods from 2007 to 2017. Tamimi & Jebreen (2018) showed that the contributions of packaged software in SMEs were in these domains: new software development life-cycle for packaged software SMEs, and enterprise resource planning (ERP). Furthermore, Tamimi, M.,

& Jebreen also (Jebreen, Tamimi, Almajali, & Janabi, 2018)presented in their 2018 systematic snapshot review the integration testing in enterprise resource planning (ERP) at SMEs to the thirty published papers between the periods from 2013 until 2017. The investigations revealed different classifications. These classifications differed in accordance with the goal investigated by researchers.

However, in this current investigation the researchers aim to introduce an investigation of the custom-made software from an in-house software development perspective.

3. MATERIAL AND METHOD

In this context, we conducted and adopted a Systematic Mapping Method (SSM) which is a procedure aims to identify, evaluate and interpret the gathered resources based on a structured strategy that was endorsed by Petersen et al. (Petersen, Feldt, Mujtaba, & Mattsson, 2008) created this method to develop systematic snapshot approach and to create a classification schema to the fields of software engineering. Moreover, the researchers adhered to the guidelines for the implementation of the systematic literature review and the validation process to ensure rigour of the produced findings.

3.1 Systematic Mapping Process

To set the rules of systematic mapping study (SMS) investigation, we carried out a structured systematic mapping process (SMP). This approach was followed to answer specific research questions using a specific research process/approach. Papers' abstracts were searched using specific keywords. This process is described in detail in the next paragraph. Data extraction and mapping is shown in figure 1.

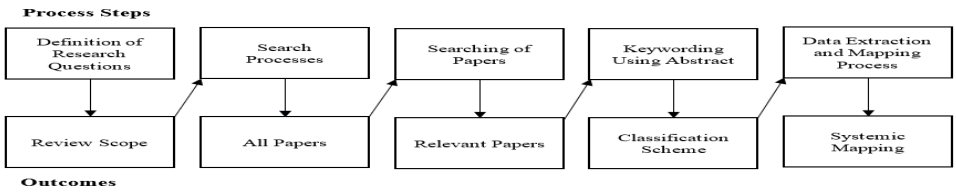

Figure 1: Systematic Mapping Process (Petersen et al., 2008)

3.1.1 Research Question

This study concentrates on answering a number of research questions. In fact, investigating and targeting an area in the software engineering does not usually present a new problem domain. The problem domain is identified through understanding the existing resources such as strategies, approaches, models, processes, techniques, and tools. Doing so allows the researchers and industrial practitioners to adapt the state-of-the-art software development systems. For the purpose of presenting the research questions, table 1 shows the primary three Research Questions (RQ) in addition to describe the motivation of each given research question.

Table 1: Research Questions and Motivation

No.	Research Question	Motivation
RQ1	*What are the investigation fields of custom-made software In-house software development companies?*	*We should first identify the former resources and investigations in different dimensions in the development aspects.*
RQ2	*What are the current trends when classifying custom-made software in the different schemas?*	*We should second find the software development aspects and analyze individually each paper and then grouping into the phases of the software development lifecycle.*
RQ3	*How is the research being carried out in the custom-made software in the development perspectives?*	*We should finally discuss the findings of classification results to the one hundred and two relative research papers in order to benefits, research gap, and limitations.*

3.1.2 Search Process

In this part, we addressed the literature search process to enable the researchers to produce a review protocol that ensures the validity and reliability of resources. There is a clear mechanism to conducting the review protocol according to the Petersen approach (Petersen et al., 2008). We followed a structured strategy of the combined. Collected keywords that are intended to inform the scope of this study. Initially, the main keywords used in the literature review of this study concentrated on using the custom software which is also known as bespoke software or tailor software. The researchers used the keywords custom software OR bespoke software OR tailor software to search the database. To identify whether the research was conducted in large development organizations or small development organizations, we used the keywords (Large OR Small OR SMEs). For the development aspects of the In-house software development companies, we used the keywords (development OR strategies OR approaches OR models OR processes OR technique OR tool OR factors). The combination of these keyword groups was further combined using the "AND" and "OR" operators to create the search string and employ them in the search engines of database libraries as shown in figure 2.

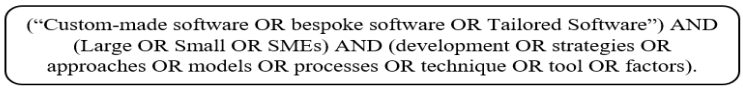

Figure 2: List of Keywords Used in the Search Strings

We carried out the search strings on several data sources were carefully scanned to retrieve the useful studies that satisfy the scope of our study. Primarily, we used web search engines that have scientific digital libraries such as ACM, Springer Link, IEEE Xplore, Science Direct Elsevier, IJEIS, and Wiley to gather relevant articles.

3.1.3 Screening of Relevant Papers

This step was utilized to screen the relevant papers that were obtained by a particular domain in the established inclusion and exclusion criteria. These processes were intended to confirm whether the shortlisted papers should be accepted or rejected by checking the inclusion research criteria with the characteristics of the gathered articles. For that purpose, the inclusion criteria identifies as follow; (a) the focus of the studies' abstract and paper is compatible with keywords of these strings (development, model, framework, tool, challenges, problem, improvements, techniques, approaches, lessons, and practices), (b) the studies should address the large or SMEs context, (c) the studies' research methodologies include (survey, case study, experiment, and others), (d) the studies are produced in English language. On the other hand, the exclusion criteria were as follows; (a) the studies are not presented in full-text, (b) the studies are not produced in the English language, (c) the studies are not relevant to the economic and financial perspectives, (d) the studies are not books, presentations, or posters.

3.1.4 Data Extraction and Mapping Process

In light of the previous systematic mapping processes, we started extracting the research papers to be accepted or rejected for the scope of our investigations. We collected the 1,023 papers in the initial search and applied the inclusion/exclusion criteria, which resulted in the 179 extracted papers. Then, we rejected 66 papers after conducting the whole text review. 13 more papers were rejected after conducting seek full text. The total of 102 papers were accepted in the mapping processes as shown in the figure 3

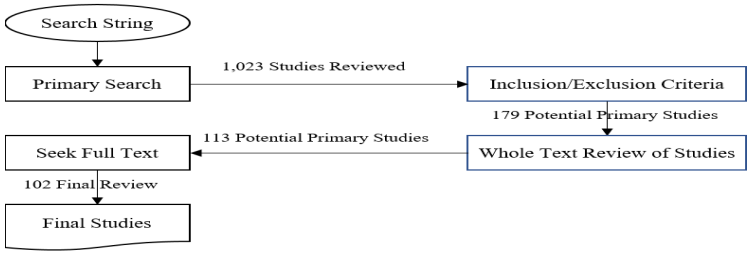

Figure 3: Data Extraction and Mapping Process Results

4. RESULTS

This section presents the findings of the systematic snapshot review conducted on one hundred and two custom-made software papers produced between the periods from 2007 to 2018. Results were obtained after dealing with the repository of relevant gathered papers, building suitable classification schemas and analysing each relevant paper in the repository according to the different types of the classification schemas. Primarily, the main classification schema is arranged according to the software development life-cycle (SDLC) phases, factors, and issues. In addition, issues such as software size categories (large or small), target countries, research method type, publishers, article types, year of publication and custom-made application names classification schemas were taken into consideration.

4.1 Aggregating the Classification Schemas

Building a schema is defined as establishing a protocol strategy to construct a different kind of classification. The followed processes of aggregating the classification schemas in this research were that adopted from Petersen, Kai, et al. (Petersen et al., 2008) as shown in figure 4. In this context, we concentrated on the keywords that were relevant to the development fields in addition to validating the gathered papers within the scope of this research interest. After validating the set of keywords, we analysed the papers that search process yielded to help the researcher to establish previous research contribution and understand the research objectives by aggregating different kind of categories.

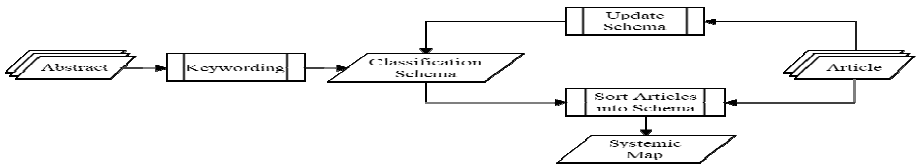

Figure 4: Classification Scheme Aggregation Processes (Petersen et al., 2008).

The gathered papers were analysed in a set of clustered categories. we aggregated the new categories to build new classification schemas that were compatible with SDLC (Planning, design, development, testing, deployment, and maintenance) phases, factors, software size, software applications, publication year, publishers and articles indexed by, as shown in table 2.

Table 2: Final Set of 9 Associated Classification Schemas

SDLC	Software Size	Software Applications
Phases; Planning, Design, Implementation, Testing, Deployment, Maintenance.	Large, Small-and-medium enterprises (SMEs)	Management applications, E-Commerce applications, Mobile applications, Web applications, Widows form applications, Cloud applications, Tool applications,

Factors; Sub-factors;		And others.
Year of publish	**Publishers**	**Articles indexed**
Targeted countries	**Top articles citations**	**Research methodologies**

4.2 Software Development Life Cycle Findings

According to the importance of software development based on SDLC, this paper presented a vast analysis of the collected 102 papers that were focused on custom-made software development perspectives. The parts of analyses included the planning phase, design phase, development phase, testing phase, deployment phase, and maintenance phase. It also included 15 important factors in management, organization, strategic, and technological issues as shown in the next parts of this section.

4.2.1 Planning Phase Classification Findings

The initial phase of the SDLC intended to develop a project charter, project plan, resource plan, financial plan, quality plan, risk plan, acceptance plan, communications plan and a procurement plan. In fact, this phase is very critical to study the requirements negotiated with the clients in the domain of business functional and non-functional requirements. This phase forms the roles and responsibilities between the stakeholders, authorities of the identified stakeholders. Table 3 presents the results of one hundred and two relevant analysed articles.

Table 3: Classifications Based on Planning Phase

	Factor	Sub-factors	Ref
Planning Phase	Project management	Study the source of requirements	(O'Connor, 2014; L. Xu & Brinkkemper, 2007)
		Ensure interdepartmental cooperation	(Turner, Ledwith, & Kelly, 2010)
		Define a clear program and required resources	(O'Connor & Laporte, 2014; O'Connor, 2014)
	Change management	Allow a widely sharing of the core values	(Fernández, Wagner, Lochmann, Baumann, & de Carne, 2012)
	Data management	Study data requirements	(Fee, 2016; Forza & Salvador, 2008; Iqbal, Zaidi, & Murtaza, 2010; Laar, Konjaang, & Tankia, 2014; Smith, Rycroft, Harman, Scott, & Roberts, 2009; Sulayman, Urquhart, Mendes, & Seidel, 2012)
	Organization characteristics	Argue a case of Enterprise Systems	(Allison, 2010; Sinard & Gershkovich, 2012)
	User involvement	Assign users' delegates with excellent knowledge of organizational processes	(Iqbal et al., 2010; O'Connor & Coleman, 2009)
	Project team competence	Skilled project team	(Rolandsson, Bergquist, & Ljungberg, 2011)
	Support of top management	Allocate adequate resources	(O'Connor & Laporte, 2014; O'Connor, 2014)
		Make sound decisions	(Deep, Guttridge, Dani, & Burns, 2008; Iqbal et al., 2010; Lamersdorf, Munch, & Rombach, 2009; O'Connor & Laporte, 2014, 2018; Ofoegbu, Griffiths, & Heinze, 2011; Petersen & Wohlin, 2009; Pino, García, & Piattini, 2008; Svahnberg et al., 2010; Verma, 2010)
	Enterprise system	Plan the reliability performance measures	(Richert, 2017)
	Software development	Strong attention to techniques, skills, integrated legacy and third-party systems	(Sinard & Gershkovich, 2012)
	Vendor	Learn the corporate business processes, industry best practices and vendor processes and vision	(Ilyas & Khan, 2017; Leach, 2010; O'Connor & Coleman, 2009; O'Connor & Laporte, 2014, 2018; Rodríguez-Dapena & Buitrago-Botero, 2015; Rolandsson et al., 2011; Tauterat, Mautsch, & Herzwurm, 2012; Wieczorkowski, Pawełoszek, & Polak, 2015; M. Wynn, Turner, Banik, & Duckworth, 2016)
	Environment	Analyze the industry's level of differentiation	(Don, Hasselman, & Wilbrink, 2011; Gray, 2011)
		Analyze business opportunities	(Sceulovs & Gaile-Sarkane; Sinard & Gershkovich, 2012)

4.2.2 Design Phase Classification Findings

System design is a crucial phase to address the identified design requirements that informs the material processes of software engineering architectures, models, frameworks and other system design aspects. This phase clearly affects the structure and software behaviours such as organization of the developed software system. These system behaviours, including Model-driven engineering (MDD, MDE, UML), flowcharts, Data Flow Diagram (DFD), Entity Relational (ER), etc., shape an organized process to accomplish the system design phase. Table 4 presents the analysis of the one hundred and two relevant articles to reveal the discovered 19 research papers in this phase.

Table 4: Classifications Based on Design Phase

	Factor	Issues	Ref
Design Phase	Project management	Follow standard architectures	(Dzamashvili Fogelström, Gorschek, Svahnberg, & Olsson, 2010; Kath, Schreiner, & Favaro, 2009)
		Follow model based implementation	(Dzamashvili Fogelström et al., 2010; Kath et al., 2009)
	Change management	Change unclear software architectural representations	(Scacchi & Alspaugh, 2017)
	Data management	Study up-front architecture planning	(Waterman, Noble, & Allan, 2013)
		Study previous systems design data	(Laar et al., 2014)
	Strategy and methodology	Contrast with design pattern	(Fernández et al., 2012)
	Education and training	Improve design guidance, practices	(Bass, 2016; Gorschek, Tempero, & Angelis, 2014; Kruchten, 2013; Lang & Fitzgerald, 2007)
		Study contextual aspects for architectures software development	(Kruchten, 2013)
	Enterprise system selection process	Ensure usage a high-level of standards	(Artz, Van De Weerd, & Brinkkemper, 2010; Bass, 2016; Deep et al., 2008; O'Connor & Laporte, 2014, 2018; O'Connor, 2014)
	Software development	Studying current product re-design impact	(Barton & Thomas, 2009)
		Strong attention to communities through a system architecture and template design	(Perumal, Sulaiman, Sharif, Ramli, & Leong, 2013; Rauschecker et al., 2011; Smith et al., 2009)

4.2.3 Implementation Phase Classification Findings

The implementation process is used to reflect the requirements and design phase specification processes that are coded using specific programming language. This phase produces the running systems that meet customer specific requirements that were accurately specified in the contracts. This phase emphasizes the importance of following the managerial, organizational, and technical factors that inform the part development in the practice excellence. Table 5 resulted in analysing the gathered one hundred and two relative papers to reveal the discovered 37 research papers in this phase.

Table 5: Classifications Based on Implementation Phase

	Factor	Issues	Ref
Implementation Phase	Project management	Manage conflicts	(L. Xu & Brinkkemper, 2007)
	Change management	Develop business justification	(Abeywardena & De Coster; Duhan, 2007; Sceulovs & Gaile-Sarkane)
		Have a "buy-in" by all major stakeholder's strategy	(Sinard & Gershkovich, 2012)
	Data management	Plan data model	(Forza & Salvador, 2008)
	Strategy and methodology	Develop uncertainties handling methodology	(Duhan, 2007)
		Determine hardware standardization	(Farooque et al., 2013)
		Make middleware approach, switching module	(Perumal et al., 2013)
	Monitoring	Monitor project progress	(P. Xu & Ramesh, 2008)
		Develop performance measures	(Ivarsson, 2018; Ramasubbu, Cataldo, Balan, & Herbsleb, 2011)
	Education and training	Develop users training programs	(Laakso, 2017; Laporte et al., 2008)
	Enterprise system	Consist on best practices	(Alamdy & Osman, 2017; Gorschek, Gomes, Pettersson, & Torkar, 2012; Laporte et al., 2008; Leach, 2010; O'Connor & Coleman, 2009; Pino et al., 2008; Rodríguez-Dapena & Buitrago-Botero, 2015; Smith et al., 2009; Tomiwa, 2015; Wagner, 2017)
	Enterprise system selection process	Make continues justification of additional functionality through applications	(Fee, 2016; Khurum & Gorschek, 2011; Matar, 2015)
	Software development	Technical response mechanism	(Ciolkowski, Heidrich, Simon, & Radicke, 2008; Farooque et al., 2013; Fee, 2016; Papaloizou & Komodromos, 2009; Perumal et al., 2013)
		Appropriate modelling methods	(Akbar, Hassan, & Abdullah, 2012; Bonomi Santos & Spring, 2013; Dick, Kern, Drangmeister, Naumann, & Johann, 2011; Lingannavar & Yammiyavar; Paulson, Sobester, & Scanlan, 2017; Richert, 2017; Schubert & Merian-Str, 2015)
	Vendor	Employ IT vendors' skilled representatives	(Aduamoah, 2017; Ilyas & Khan, 2015)

4.2.4 Testing Phase Classification Findings

The testing phase is highly necessary to be utilized during and after building a software system in order to achieve a diverse organized level of testing types such as unit testing, integration testing, system testing, and acceptance testing. These types of testing ensure the correctness of the system functionality before delivering the software to the customers that must be satisfied with given functionalities. Table 6 resulted in analysing the gathered one hundred and two relative papers to reveal the discovered 23 research papers in this phase.

Table 6: Classifications based on Testing Phase

	Factor	Issues	Ref
Testing Phase	Project management	Emphasis on a test plan to end of a project.	(Bass, 2016; Ilyas & Khan, 2017)
		Knowledge transfer	(Artz, Van De Weerd, & Brinkkemper, 2010; Gorschek et al., 2012; Iqbal et al., 2010; M. Wynn & Turner, 2013; M. G. Wynn, Shen, & Brandao, 2008)
		Engaging the 'pragmatic satisficing' with 'tried-and-tested' solution	(Lang & Fitzgerald, 2007)
	Change management	Enhance "performance priority" policy rather than "seniority priority"	(Aslan, Stevenson, & Hendry, 2015; Ciolkowski et al., 2008; Ramasubbu et al., 2011)
	User involvement	Break old habits of manual work	(Arpaia, De Matteis, & Inglese, 2015; Parry, Rowley, Jones, & Kupiec-Teahan, 2012)
	Environment	suitable decision criteria for analyzing testing software systems	(Arpaia et al., 2015)
		Analyze problems resulting from lack of integration	(Barton & Thomas, 2009)

	Enterprise system	Ongoing stream of upgrades to fix bugs, regulations and new functionality	(Sinard & Gershkovich, 2012)
	Vendor	Analyze vendor's ongoing and future changes	(Saqib, Jan, Ahmad, Ahmad, & Asghar, 2011)
	Software development	Arrange the internal testing, in house testing, and external testing	(L. Xu & Brinkkemper, 2007)
		Practicing testing efforts on the technical challenges	(Fernández et al., 2012; P. Xu & Ramesh, 2008)
		Testing a measurement method	(Arpaia et al., 2015; Dick et al., 2011)
	Monitoring	Analyze feedback from clients through beta tests	(Aranda, Easterbrook, & Wilson, 2007; L. Xu & Brinkkemper, 2007)
	Enterprise system selection process	Emphasize to support technologies of testing tools.	(Petersen & Wohlin, 2009)
		Component/Unit Testing prior to integration Testing	(Ilyas & Khan, 2015, 2017)

4.2.5 Deployment Phase Classification Findings

This phase is intended to inform the software system release as a finished product to the customers after practicing different types of software testing. In brief, this phase presents a software system after successfully completing each type of testing to be ready to go live. Therefore, this phase focuses on the principles, strategies, models of system release, best practices to release the systems and lessons of former implementation of the release. Table 7 resulted in analysing the gathered one hundred and two relative papers to reveal the discovered 32 research papers in this phase.

Table 7: Classifications Based on Deployment Phase

	Factor	Issues	Ref
Deployment Phase	Project management	Choosing a proper delivery approach	(L. Xu & Brinkkemper, 2007)
		Analyze objectives and expected outcomes in light of existing ES, corporate strategy, legacy system, future standardization and regulations	(Allison, 2010; Haug, Ladeby, & Edwards, 2009; Jones & Rowley, 2009; Kalus & Kuhrmann, 2013; Mishra & Mishra, 2009; Savolainen, Ahonen, & Richardson, 2012; Sceulovs & Gaile-Sarkane; Wieczorkowski et al., 2015)
	Change management	Study former obstacles	(Haug et al., 2009; Mateer & Jones, 2018)
	Data management	Define applications needed for data management	(Arpaia et al., 2015; Smith et al., 2009)
	Organization characteristics	Ensure the coordination and cooperation of all stakeholders affected by new module implementation	(Fabriek, van den Brand, Brinkkemper, Harmsen, & Helms, 2008)
		Develop high level of usage and efficacy	(Johansson, Deliallisi, & Walraven, 2016; Khurum & Gorschek, 2011)
	Project team competence	Strengthen the project team with relevant to module personnel and consultants	(Pino et al., 2008)
	Strategy and methodology	Analyze strategy in light of previous implementations	(Fabriek et al., 2008; Ramasubbu et al., 2011; Rolandsson, Bergquist, & Ljungberg, 2009; Rolandsson et al., 2011; Sulayman et al., 2012; P. Xu & Ramesh, 2008)
		Increase best practices used in security defenses	(Pan & Fung, 2011)
	Monitoring	Define monitoring measures for unsolved obstacles that affect new module implementation	(Arpaia et al., 2015)
	Education and training	Enhance users' knowledge and efficacy	(Fricker, 2012)
		Train on future interfaces, obsolete legacy systems, data quality, etc.	(Scacchi & Alspaugh, 2017)
	Enterprise system	Study lessons of former implementation	(Bailetti, 2012; Ciolkowski et al., 2008; Fafoutis, Elsts, Piechocki, & Craddock, 2018; Santos et al., 2007; Sundaresan, Burnett, Feamster, & De Donato, 2014)
	Enterprise system selection process	Performing post implementation gap analysis of the current fit application	(Aslan et al., 2015; Matar, 2015)
		Analyze different modules implementation considering multiple vendors and infrastructure considerations	(Jing & Yang, 2015)

	Environment	Analyze trading partner readiness to integrate its business	(Barton & Thomas, 2009)
		Analyze own ability to alter new rules of competition and leverage new ways to outperform rivals	(Bailetti, 2012)

4.2.6 Maintenance Phase Classification Findings

This phase is intended to deal with the issues of system repairs and upgrade. It is concerned with maintaining the legacy or existing systems that have higher possible risks to retiring these systems. It is also concerned with issues regarding system upgrades in accordance with the vendor support to meet the updates in the management, organization, development, and cultural changes. This phase supports different strategies, models, frameworks and other development perspectives to understand the ability to upgrade and maintain a software system. Table 8 resulted in analysing the gathered one hundred and two relative papers to reveal the discovered 23 research papers in this phase.

Table 8: Classifications Based on Maintenance Phase

	Factor	Issues	Ref
Maintenance Phase	Project management	Align expectations of capability, complexity, knowledge gap, barriers removal	(Barton & Thomas, 2009; Kuivalainen, Lindqvist, Saarenketo, & Äijö, 2007; Waterman et al., 2013)
	Change management	Organizational understanding of the importance of infrastructure upgrades	(Mijnhardt, Baars, & Spruit, 2016)
	Organization characteristics	Analyze the experience gained throughout initial implementation	(Lamersdorf et al., 2009; Saqib et al., 2011)
		Analyze specific organizational challenges	(Bonomi Santos & Spring, 2013; Ilyas & Khan, 2017; Lamersdorf et al., 2009; Mijnhardt et al., 2016; Sundaresan et al., 2014; Verma, 2010)
	Strategy and methodology	Make use of experts	(Artz, van de Weerd, Brinkkemper, & Fieggen, 2010; Deshpande & Richardson, 2009)
		Understand potential upgrade issues	(Hrubeš; Johansson et al., 2016; Salem, 2012; Sundaresan et al., 2014)
	Monitoring	Ensure former users' satisfaction	(Dzamashvili Fogelström et al., 2010)
		Ensure end to end operation	(Dzamashvili Fogelström et al., 2010)
	Enterprise system	Analyze implications on current processes	(P. Xu & Ramesh, 2008)
	Enterprise system selection process	Carefully select infrastructure upgraded elements in light of technical or business improvements needs	(Don et al., 2011; Mishra & Mishra, 2009; Rauschecker et al., 2011; Salem, 2012; Sundaresan et al., 2014; Tamimi, 2018)
		Analyze ease of maintenance efforts	(Don et al., 2011; Hrubeš; Saqib et al., 2011; Verma, 2010)
	Software development	Analyze the benefits of reducing the existing customizations, enhancements and operational cost	(Ballsun-Stanton, Ross, Sobotkova, & Crook, 2018)
	Vendor	Usage of infrastructure modelling tools	(Costache, Kalus, & Kuhrmann, 2011; Smith et al., 2009)
	Environment	Analyze changes in environmental uncertainties	(Sundaresan et al., 2014)

4.2.7 Systematic Snapshot Mapping Findings

After classifying the collected 102 papers based on SDLC phases, factors, and sub-factors, we demonstrated the perspectives of development for the custom-made software using a bubble chart to display the number of used research papers for each SDLC phases and factors. Figure 5 summarized our primary results by illustrating the founded contributions, trends, and gaps among the analysed studies. It shows that the number of research papers have heavily focused on support of top management, vendor, data management, and project management in the planning phase. While in the design phase, there were many gaps among the analysis. In the implementation phase, researchers have focused on software development, and enterprise system significantly. In the testing phase, researchers clearly have focused on project management and there were a number of gaps. In the deployment phase, researchers have focused on project management, strategy, and methodology. Finally, in the maintenance phase, researchers have focused on Organization characteristics and Enterprise system selection process.

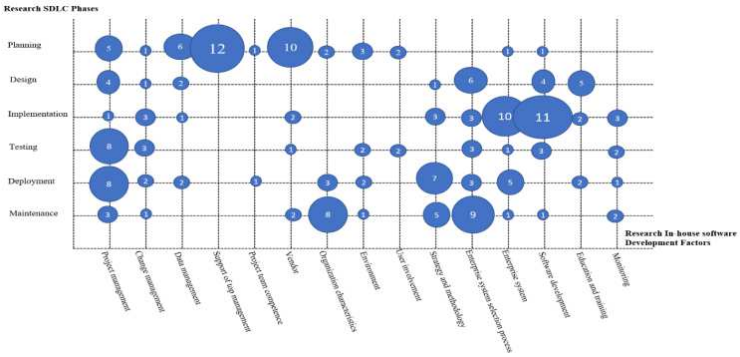

Figure 5: Bubble Systematic Snapshot Mapping Results

On the other hand, we categorized the gathered one hundred and two papers according to SDLC phases after conducting the bubble systematic snapshot mapping results. The results generated after removing the duplicates of the referenced factor many times in its sub-factors. Figure 6 shows that the highest number of research papers addressed the implementation phase (37 research papers). While the lowest number of research papers addressed the design phase (19 research papers). The requirements phase resulted in 34 research papers. The testing phase yielded 23 research papers. The deployment phase resulted in 32 research papers. Finally, the maintenance phase resulted in 23 research.

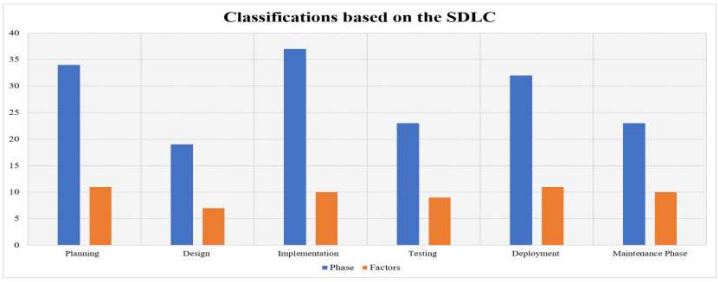

Figure 6: Classifications Based on the SDLC Findings

4.3 Software Sized Classifications

Recently, there has been a huge growth in the number of software enterprises, especially small and medium-sized enterprises (SME). This tendency compels the researchers to concentrate on studying representing models, frameworks, processes, tools, and techniques for SMEs projects from different perspectives. Based on the EU, a classification of software enterprises size is divided into two main types; large and SMEs. The large enterprises are classified according to the number of employees within the company which usually exceeds 250 employees. The SMEs are classified into three types (micro, small, small to medium); microenterprises usually employ less than 10 employees, small enterprises usually employ less than 50 employees. Finally, medium size enterprises usually employ employees more than 50 employees but less than 250 employees(Commission, 2003). In this part, we classified the one-hundred and two relevant papers based on the software enterprise size. Figure 7 shows that 50 articles carried their investigations in SMEs, 20 papers investigated the large systems, and the rest of the papers did not mention the size of software enterprise.

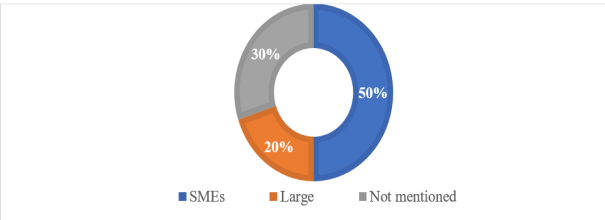

Figure 7: Classifications Based on Software Size

4.4 Software Application List Findings

This section shows a variety of application lists that can be used by sectors to name a few: information systems, business companies, universities, organizations, governments, healthcare, aircraft, and other sectors. These types meet a specific demand, and features that are specified by clients of custom-made software. For demonstrating the various usage of the custom-made software, we extracted the name of custom-made applications from the one hundred and two relevant papers. The findings show that 33 applications were investigated or researched between the periods from 2007 to 2018. This is shown in table 9 below.

Table 9: Classifications Based on Software Application Lists

Application Name	Ref.	Application Name	Ref.
Custom E-Commerce application	(Hrubeš; Schubert & Merian-Str, 2015)	Custom Sales Management System	(Laar et al., 2014)
Custom Mobile Application	(Fee, 2016)	Higher Education Information Systems	(Tomiwa, 2015)
Content Management System	(Dick et al., 2011; Smith et al., 2009)	Unmanned Aircraft System	(Paulson et al., 2017)
Custom ERP Projects	(Deep et al., 2008)	German Car Retailer	(Richert, 2017)
Start-ups Project	(Bailetti, 2012; Johansson et al., 2016)	Custom Computerized AccountingSoftware	(Aduamoah, 2017)
E-Learning Bespoke Solution	(Salem, 2012)	Custom Laboratory Information System	(Sinard & Gershkovich, 2012)
E-portfolio of educational system	(Matar, 2015)	Custom Image Processing Software	(Farooque et al., 2013)
Custom Product Life Cycle Management System	(M. G. Wynn et al., 2008)	Bespoke Embedded System	(Perumal et al., 2013)
Custom Financial Services Projects	(M. G. Wynn et al., 2008)	Custom Smart Home Management System	(Perumal et al., 2013)
Tailored Banks Enterprise Applications	(Aranda et al., 2007)	Home Routers Running Custom Software	(Sundaresan et al., 2014)
Custom Management Information Systems	(Duhan, 2007)	Custom Simulations	(Papaloizou & Komodromos, 2009)
Data Management Systems	(Forza & Salvador, 2008)	Specialist Autism Education Projects	(Leach, 2010)
Domestic Firm	(Kuivalainen et al., 2007)	Custom Defensive Solutions	(Pan & Fung, 2011)
Healthcare Specific System	(Ivarsson, 2018)	Night Vision System	(Mateer & Jones, 2018)
Custom Customer Relationship Management	(Bass, 2016; Forza & Salvador, 2008; Laakso, 2017; M. Wynn et al., 2016)	Custom Cloud-Based Application	(Rauschecker et al., 2011; Saqib et al., 2011)
Custom Web-Based Systems	(Abeywardena & De Coster; Ciolkowski et al., 2008; Lang & Fitzgerald, 2007; Sulayman et al., 2012; Waterman et al., 2013)	Custom Service Management Solution	(Ofoegbu et al., 2011)
IoT Custom Solution	(Fafoutis et al., 2018)		

4.5 Years of Publish Findings

This section shows the results according to the process of extractions on the year of publication of the one hundred papers between the years 2007 to 2018. The line graph in figure 8 shows the number of papers produced in the last twelve years.

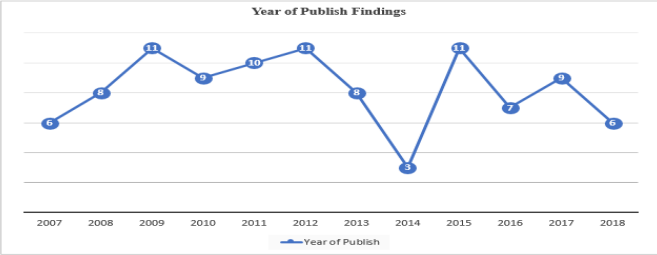

Figure 8: Classifications Based on Year of Publish

4.6 Targeted Countries Findings

In this section, we present the specific locations of the conducted 102 research studies. Table 10 shows the classification based on the target countries. 31 different target countries were the setting where the research was conducted. Interestingly the UK was highly represented in research for investigating different perspectives of custom-made software applications.

Table 10: Classifications Based on the Targeted Countries

Country	#	Country	#
UK	14	Switzerland	2
Ireland	6	China	2
India	6	Pakistan	2
Sweden	5	Hong Kong	2
Germany	5	Peru	2
Canada	4	Romania	2
Brazil	3	Luxembourg	2
France	3	Thailand	2
Austria	3	Georgia	1
Malaysia	3	Tunisia	1
Finland	3	Nigeria	1
Cyprus	3	Israel	1
Ghana	3	Czech	1
USA	3	Denmark	1
Colombia	3	Egypt	1
Netherlands	2		

In this part, we presented the extracted data in table 10 as a map graph which is shown in figure 9. The data revealed a dramatic change of colours on the map graph from dark green to light green. The dark green colour that represented the highest number of research papers investigating custom-made software. The light green colour represented the least number of research papers investigating custom-made software. UK fell on the dark green spectrum while Egypt fell on the light green colour spectrum.

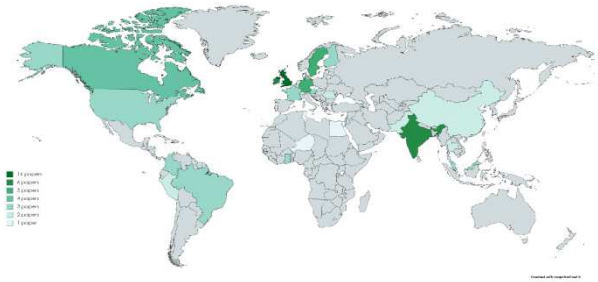

Figure 9: Map Graph for Targeted Countries

4.7 Top Ten Papers Citations Findings

This classification shows the highest number papers cited by other researchers. The highest citation indicates a greater interest in the research as a research tool. It also indicates the tremendous quality level of the paper and findings. These increased citations pose as advantages that encourage other researchers to engage in an evidence-based research, to inform their own research process and to utilize the research findings in other fields of interest. The results for the top ten cited research papers are shown in table 11 below.

Table 11: Classifications Based on Top Ten Papers Citations

Ref.	Year	Place of publish	Citation No
(Pino et al., 2008)	2008	Software Quality Journal	288
(Petersen & Wohlin, 2009)	2009	International Symposium on Empirical Software Engineering and Measurement	197
(Laporte et al., 2008)	2008	European Conference on Software Process Improvement	159
(Turner et al., 2010)	2010	International Journal of Project Management	139
(Deep et al., 2008)	2008	Journals & Books Journal of Manufacturing Technology Management	136
(Svahnberg et al., 2010)	2010	Information and Software Technology	136
(L. Xu & Brinkkemper, 2007)	2007	European Journal of Information Systems	134
(Savolainen et al., 2012)	2012	International Journal of Project Management	133
(Kruchten, 2013)	2013	Journal of Software: Evolution and Process	101
(Aranda et al., 2007)	2007	15th IEEE International Requirements Engineering Conference (RE 2007)	98

4.8 Research Methodology Findings

In this part, our results indicate that a number of research papers used the conceptual method for the analysis of specific issues. Other research papers used the case study method either mainly to investigate a situation that has not been studied before or to describe the behaviour of practitioners during and after the implantation phase. A number of researchers used the qualitative approach to collect and analyse data about a particular phenomenon. Other researchers have used the quantitative method to collect and analyse data from a large group of people and to represent the results as statistics. Moreover, empirical studies used observation, experimentation, and other techniques to gather and analyse data. Additionally, a number of research papers used the literature review method in the process of gathering information. And, a number of research papers literally used the survey to gather information about a particular phenomenon. Figure 10 shows the statistical findings of the research methodologies used by the 102 relevant research papers.

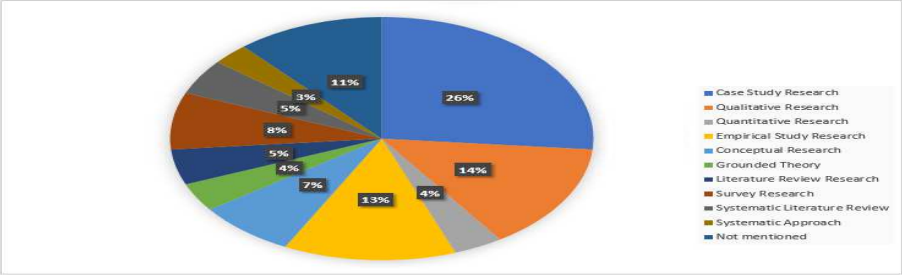

Figure 10: Classifications Based on Research Methodologies

4.9 Research Publisher Findings

This section contains the statistics of one hundred and two papers produced between the periods from 2007 to 2018 according to the name of the publishers. Table 12 presents the results of publishing classifications based on the publisher name. 24 publishers have published 55 journal papers and the highest number of papers were published by

Elsevier, publisher of which were 16 journal papers.

Table 12: Classifications Based on Journals Publisher

Publisher Name	#	Publisher Name	#
Journals			
Elsevier	16	University of Limerick Institutional Repository	1
Taylor & Francis Online	6	ComSIS Consortium	1
Emerald insight	5	Biodiversity Informatics	1
Wiley online	5	IJCSIS	1
Springer	3	TIM Review	1
IGI Global	2	Inderscience	1
IEEE	2	IJIRAE	1
SERSC	1	IJETMAS	1
NCBI	1	INFORMS	1
WSCIT	1	Archives of Business Research	1
Cambridge	1	RESAFE	1
Semantic scholar	1		

As for the conference publishers, the number of relevant papers showed that 35 papers have been published in conferences. The highest number of papers, 13 papers in total, were published in the IEEE. The number of published papers slightly decreased to 8 papers in Springer, then it sharply fell down to 2 papers in the ACM and ESEM conferences and other publishers managed to include 1 paper only in conferences. Table 13 below shows the results for Classifications Based on Conferences Publishing.

Table 13: Classifications Based on Conferences Publisher

Publisher Name	Ref	Publisher Name	Ref
Conferences			
IEEE	13	Environmental Informatics	1
Springer	8	AISEL	1
ESEM	2	OLKC	1
ACM	2	eChallenges e-2011	1
University of Oxford	1	INASE	1
e-Society	1	University of Gloucestershire	1
iNCEB2010	1	USENIX	1

As for analysis of report publishing, the relevant papers showed that 12 papers have been published by workshops or reports. These reports were presented as technical reports and others presented as theses in different universities. Results are shown in table 14.

Table 14: Classifications Based on Workshop, Reports Publisher

Publisher Name	#	Publisher Name	#
Workshop, Reports			
RESAFE	1	Utrecht University	1
iNCEB2010	1	Zarqa University	1
Walden University	1	University of Ghana	1
Aalto University	1	UWM: University of Wisconsin-Milwaukee	1
Linköping University	1	NPS: Naval Postgraduate School	1
ITGS	1	Masaryk University	1

4.10 Articles Indexed Findings

In this section, figure 11 illustrates the statistical analysis of articles indexed to the journal paper ranking in terms of 39 Scopus ranked journals and other 18 journals. The number of identified 35 conference papers and the number of 12 reports.

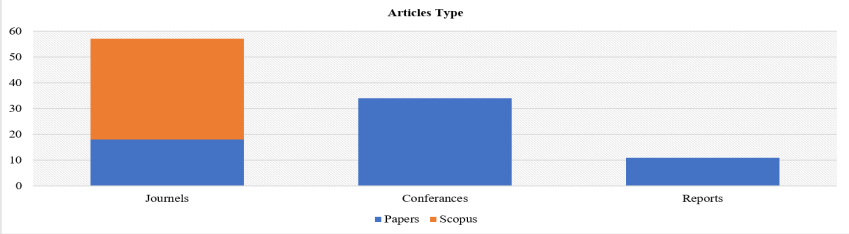

Figure 11: Classification Based on Article Types

5. CONCLUSIONS

We implemented a comprehensive systematic snapshot literature review on the custom-made software enterprises with an interest of development perspectives. A comprehensive research was used to find out the journal, conferences and reports, papers using the digital library search engines such as Elsevier, ACM, Springer Link, and IEEE Xplore in addition to the Google Scholar. We scanned a vast number of research papers using our inclusion and exclusion criteria which resulted in 102 papers relevant to the custom-made software. Following that, we classified these papers to the 9 identified associated classification schemas. This study resulted in that there was a high concentration of research interest in the implementation phase at the SDLC and fewer concentrations of research interest in the design and testing phases. The Bubble systematic snapshot mapping result revealed on the covered and uncovered contributions of 102 collected papers on the identified 15 factors. Some of these factors were covered by researchers, while other factors were not covered to be as a gap field and a research trend. Moreover, this study demonstrated that there was a higher research interest in the custom-made software at SMEs, a higher trend to use case study methodology, a high number of researches conducted in the UK and that the majority of articles were published in journals with indexed Scopus. Consequently, the significance part of this paper stems from the fact that it identified the common research trends to development perspectives in custom-made software enterprises based on the covered and uncovered systematic mapping contributions.

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